NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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THE PLANETARIUM IN SPACE EDUCATION

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When I accepted the President's invitation to head the National Aeronautics and Space Administration, I did so with great humility. I was acutely aware that this new field of scientific and technological activity was to constitute an exciting and difficult challenge. Nothing that has happened during my 4 months in Washington has caused me to revise these feelings. Indeed, the demands of the job, in terms of organizational development, inter-agency and congressional relationships, recruiting of new and able personnel, and the development of a National Space Program in the midst of the urgent tasks of the moment, have left me little time for pleasant occasions such as this one.

However, when Robert Adler and Warren Johnson told me of the purpose of this meeting, I could not refuse their invitation to visit with you -- not as an expert on space, but simply as a person with a deep and abiding interest in people, in education, in science, and in matters of the spirit. This will be a rather disjointed discussion, with elements of each of these interests woven into my discourse.

You are here today because of a common interest in a planetarium -- to be more specific, the Adler Planetarium, which was the first such

institution in the Western Hemisphere.

You know, there is something compelling in any activity that raises men's eyes to the stars. This feeling is not particularly new among human beings. The wonders of the heavens intrigued and fascinated the shepherds of old. From such beginnings came the study of astronomy, the first and oldest of the sciences. From the same impulse, in the fisherman, sprang the art of navigation.

In our urban communities today, people rarely observe the sky, or watch the stars rising and setting. Yet our need to orient ourselves, in the universe as a whole, is as great as it was for those who lived in earlier ages. To city dwellers like ourselves, the Planetarium is a necessary device, to bring into focus all those mind-stretching, ever-absorbing phenomena of the cosmos around us.

A planetarium gives us far more than a mere spectacle, wonderful as that spectacle is. It teaches us the logic of the seasons -- the cyclical behavior of most natural processes, including life itself. The planetarium provides us with a concept of the order that governs the universe, and of our place in it; conveys to us an appreciation of the immense variety in the infinitude of space -- the stars, the planets in all their diversity of form and substance, comets drifting into our solar system and moving on, the Milky Way, the galaxies, and clouds of cosmic dust floating in what was once thought to be emptiness.

Most important of all, the Planetarium impels us to learn more about all matter, leading our minds into ever more marvellous aspects of the world we inhabit. Thus it serves as an inspiration to the young, turning them toward an interest in science as a whole. Without that interest, and the discoveries that come from it, we would have no

planetarium, no technology, and, in fact, no civilization.

In generations past, we have sought, have fought for, and have won freedom from tyranny, from fear, from want -- primarily so that we could live in peace and pursue our studies of man's relationships to man and to the universe -- unhampered -- unconfined. That is what liberty means, in essence: release from persecution and privation, permitting us to devote more of our faculties to eternal questions of philosophy, religion, and science. Hence, the Planetarium also is a symbol of freedom -- one as full of meaning as the lamp in the upraised hand of the Lady on Bedloe's Island.

In recent years, man has been reaching toward another kind of freedom -- from the gravitational attraction of the earth. It is this urge that attracts us to the idea of placing manmade satellites in orbit around the earth, of landing on the moon -- where the pull of gravity is but a fraction of this planet's -- of traveling to faroff worlds, in celestial vehicles.

Of this longing, too, the Planetarium is a symbol. Many of our brilliant young scientists, our space-vehicle designers, our rocket pilots, heard the challenge of space ring out for the first time in an auditorium like that of your own Adler Planetarium.

Anyone who has ever had the thrill of piloting an airplane knows the indescribable sense of exhilaration that comes with the freedom of motion, high above the ground. There is a special beauty in clouds when they are seen at great heights, detached from the earth, and in the impassive landscape, far below.

Men who have flown fast jets or rocket craft, in weightless parabolas, tell me that there is an even greater feeling of release from bondage in zero gravity, the balancing of gravitation by

centrifugal force that is characteristic of orbital flight in space. Most pilots enjoy it. They describe it as a feeling of unearthly liberation, as if they had experienced a brief suspension of all contact with our planet.

In the Planetarium, watching the constellations wheel in stately procession overhead, we are moved by something resembling the same detachment, even though the familiar skyline of Chicago marks the horizon. It is a kind of weightlessness of the mind -- a vertigo that takes possession of us on the brink of infinity. Once it has been experienced, we are never quite the same mundane persons again.

Last summer, while I was still active as President of The Case Institute of Technology, I visited the Soviet Union with a small group of other university presidents. Our purpose was to study the Russian System of Higher Education, which is quite different in many respects from our own. One of the things that interested me particularly -- and too rather disturbed me -- about Soviet education, was the emphasis which it places on science. At all levels of the State School System, selected students are trained intensively for scientific careers.

Among the impressive cultural institutions in Moscow, one of the most popular is the Planetarium. Its equipment for the demonstration of celestial phenomena is as fine as any that we see here, or in other cities of the Western World. A replica of the first Sputnik is said to be on display there, showing some of the instrumentation to collect astrophysical data. Soviet students visit the Moscow Planetarium constantly, and in their own time, apparently from a sincere enthusiasm for knowledge of the heavens.

Incidentally, it should be well known -- if it isn t -- that your own Planetarium is able to project the paths of satellites, like our recent Atlas or the Russian Sputniks, on their shifting courses against the sky. Thus, to people who find these tiny man-made objects elusive, or below the threshold of vision, their exact orbital elements are made clear, for study or reflection.

The Moscow Planetarium is not the only one in Russia. There are many others, scattered over the vastness of the Soviet Union. In their development of an interest in science among the young, the Kremlin men make use of these dynamic representations of the stars and planets. They know that such exhibits influence the minds of growing people in the direction of scientific research and technology.

In the past year, our chagrin over the feats of Russian rocketry has speeded our re-examination of various elements in our own educational methods. Whatever the reasons, it had become painfully obvious that our school system was failing to interest many students with creative minds, in the rewards of a career in science and technology.

Those rewards are not always easy to depict. Often, they consist more of personal satisfaction in the search for knowledge, and its discovery, than of social prestige or financial gain -- Although these too, have increased for the scientist to a notable extent since World War II. Still, the scientist has to put his trust in other motives, if he is to attain some measure of success. And it had begun to seem that our youth, as a whole, no longer had faith in these motives.

I have heard various reasons given for the turning away of so many young people in America from science. One of the most convincing is that science teachers are too often insufficiently equipped to communicate the fascination of these subjects to their students.

Although this may be true, and I am inclined to believe that it is, I think that a more subtle reason may be the one that I touched on earlier in this talk. Before the rise of our predominantly urban culture, people were closer to the wonders of the natural world. The growth of a profusion of living plants around him intrigued the youth who would become a botonist; the behavior of the hosts of insects everywhere roused the curiosity of the young entomologist; and the mystery of the wide firmament overhead stirred the imagination of the boy destined to open new avenues in celestial mechanics.

Today we buy an occasional potted plant from a florist; we spray the insects with DDT; and our observation of the sky is confined to a rare passage of a satellite across a picture window. We are isolated from the world of nature by paved highways, neon lights, and air-conditioning. These developments add enormously to the convenience of our lives. But they remove us from the traditional incentives to scientific exploration.

That is why I feel it is so important to build, support, and use such graphic representations of the universe as the Adler Planetarium. They are an essential element in our modern educational system; for they show the movements of cosmic bodies in a way that no words in a lecture, no formulas on a blackboard can describe. What a tool you

have here to excite the imagination of the student -- the young boy or girl who may be impelled by the display of the cosmos in the dome of your Planetarium to seek out a way of life which will lead to a creative career in any field of science.

Fortunately, in space exploration we have a subject which also appeals more to youthful minds, and is more readily understandable to them, than to most people of my own generation. I always find it easier to discuss these matters with younger groups than with men and women whose intellectual faculties have long been oriented toward activities of a more immediately practical kind.

That isn't only because space and rocketry have an aura of adventure about them. The minds of young people are more resilient than ours. They are in the process of discovering the world around them, and adding a little more of the infinite universe is no great feat. Besides, they have been exposed to the idea of travel in space almost from the cradle. What the western cattle country was to boys in my youth, space is today.

I should add a note of warning, however, to young students who think of entering either space science or the art of piloting rocket craft. This work demands more than just a deep curiosity about the things that might be found on other worlds. Like any other serious occupation -- like music, finance, or international diplomacy -- it has its intellectual discipline and its peculiar techniques, which must be learned and practiced.

The rocket pilot, for example, is more than merely a young man who has learned to fly an airplane, and then steps into a rocket craft like the X-15, and zooms off into space. The flight of a rocket vehicle is an exact performance, plotted in advance by strict mathematical and aerodynamic rules. Men like Joe Walker, Scott Crossfield, and the late Iven Kincheloe are more than simply pilots. They are trained engineers, as well. They have to be, in order to handle a machine whose progress and stability depend on a delicate balance of tremendously powerful forces.

In my own boyhood, I was drawn to scientific studies by a taste for the technical data, as well as by curiosity about results. I was fascinated by the functions of numbers, and so I found mathematics an intriguing subject. The behavior of metals or other materials under varying conditions of heat or stress or fatigue interested me, and so I enjoyed physics and mechanics.

I realize that these technical disciplines do not have the immediate attraction for every young man or woman that they had for me. But my own experience tells me that at least they should not discourage or repel a person who is otherwise drawn to scientific pursuits. There is nothing weird or taxing to the mind, for example, in mathematics. It is simply the technique of counting and measuring things. A formula may look impossibly complicated on the printed page, but examination will show that it is merely the easiest way to express a relationship which would be highly confusing in any other terms.

One of the most useful facts about the Planetarium, then is that

it gives the student a certain familiarity with the terrain of science, a sense of being at home in studies of this kind, before he attacks the methodology. In a similar manner, after he comes to know the real objects and motions that chemistry and physics describe, he no longer finds the intellectual tools disturbing or strange.

Really, the subjects that you deal with in the Planetarium are much more abstruse than mine. In astronomy, you handle concepts involving millions of celestial bodies, many of them remote from this world by millions of light years. In space exploration, we work with nearby objects in the solar system, a few thousand or at most a few million miles away.

Long after the young people of today are grown, and some of them perhaps are assembling shelters on the Moon or on Mars, your institution will be showing future generations of scientists and astronauts the countless galaxies of stars and solar systems that remain. Whatever man's ultimate destiny may be, one of his exciting, stimulating experiences surely is here in the Planetarium, where the immensity of the universe is reduced to manageable proportions.

We are -- all of us -- engaged in some kind of space exploration. We cannot help but try to find our way in the vast universe where we have been placed, for purposes yet unknown.

I conduct my search with rocket satellites and probes, that reach a little way into the immensity of the cosmos. Using your Planetarium, you conduct yours with the human mind, which has no limits. May I humbly salute your efforts, in this new society, to extend the scope and aim of your institution for the benefit of the young -- and, through them, for the ultimate benefit of mankind everywhere.

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